

Neotypification of protists, especially ciliates (Protozoa, Ciliophora)

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Abstract. Historically, most soft-bodied species of heterotrophic protists (Protozoa) have been difficult to preserve and consequently lack type material that can be re-investigated. This causes taxonomic and nomenclatural problems and increases the degree of subjectivity in the identification of these organisms. There are hardly any ciliate species whose identity has not been queried, or will be disputed as new data become available. However, recently methods have been developed that allow ciliates (Ciliophora) to be preserved in a way that allows type material to be preserved and re-examined. The current paper proposes that ciliate species are accurately re-described and neotypes designated that can be preserved using the new methods. The paper also proposes that the Commission should consider waiving Article 75.3.6 of the Fourth Edition of the International Code of Zoological Nomenclature (1999) in relation to ciliates and other groups of protists and small Metazoa. This Article states that neotypes should be designated from specimens that come as near as practicable from the original type locality. The reasons why the Article should be waived for these organisms are discussed.

Keywords. Nomenclature; taxonomy; Protozoa; Ciliophora; protists; ciliates; neotypification; type locality.

Introduction

This paper aims to stimulate discussion about the absence of or inadequate quality of type material for protists, especially ciliates (Protozoa, Ciliophora). To date, this important problem has been largely ignored by the scientists concerned and by the scientific community in general. The lack of interest in protist nomenclatural problems is illustrated by the low number of relevant cases published in the *Bulletin of Zoological Nomenclature* and an ignorance of the International Code of Zoological Nomenclature displayed in recent publications by protozoologists. There are probably two main reasons for this: (i) there are very few people studying these minute organisms and even fewer are interested in their alpha-taxonomy and nomenclature, and (ii) there is a lack of type material, which causes nomenclatural problems and leaves identification extremely subjective. Similar problems exist in most 'microfaunal' groups and even more severely in the nematodes (Nematoda).

Inadequate type material

The lack of type material is the result of historical problems with the preservation of ciliate specimens and more than 90% of all described ciliates lack type material. Where it does exist, species are often represented by material that fails to show the diagnostic features. Further, in some cases material is difficult to obtain because it is deposited in private collections (see Foissner & Pfister, 1997).

The lack of type material is one of the most difficult problems facing protozoologists involved in ciliate or other protozoan alpha-taxonomy. There are innumerable examples of poorly described species, doubtful identifications, and problematic redescrptions. Although my own research group may recognize a thorough redescription as 'authoritative', others may not. Berger (1999), for example, assigned *Onychodromopsis flexilis* Stokes, 1887, accurately redescrbed and neotypified by Petz & Foissner (1996), to *Allotricha*, a genus and species which has never been illustrated or accurately described. Obviously, in the absence of reliable type material, no consensus can be reached and ciliate identification and nomenclature must remain a matter of choice.

Improved methods for preserving ciliates

At present, most 'modern' ciliate types are deposited at two centres: the Smithsonian Institution in the U.S.A. (Corliss, 1972; Cole, 1994) and the Biology Center of the Museum of Upper Austria in Linz (Aeschl, 1994). In the last 30 years, protozoologists have developed improved methods for preserving these soft-bodied organisms, allowing reliable type material to be obtained and preserved. Specimens are impregnated with silver nitrate and/or protargol to show the arrangement of somatic and oral cilia (known as infraciliature or the silverline system), which are among the most important features in ciliate alpha-taxonomy (Foissner, 1991). Under certain circumstances other methods such as the Feulgen reaction are used to examine the main features in the nuclear apparatus.

Usually, light- and/or electron-microscopical micrographs and molecular data alone are not sufficient for description of species, but may add important additional data to the information available from conventional (silver) preparations. The methods needed will depend on the group of protists under consideration. What is important is that the feature(s) mentioned in the description can be seen in the designated type material. Often several 'holotype specimens' might be necessary because not all features can be seen in a single specimen or preparation. Here, the concept of the hapantotypes can be applied (Article 73.3).

A solution to taxonomic and nomenclatural difficulties in the ciliates

Many protist taxonomic and nomenclatural problems could be solved by the provision of type material using the new methods mentioned above. The present practice of using illustrations as holotypes does not solve the underlying problem because these illustrations often cannot be examined to reveal new data when an existing description is found to be incomplete or inaccurate. Further, features which are considered as unimportant at the time of description may later become decisive taxonomic characters for comparison with new species. Neotypification is the one way to overcome these and related problems and to bring stability in ciliate taxonomy and identification. This was emphasized by Corliss (1972), who established some neotypes for 'difficult' ciliates in the sixties. Likewise, Medioli & Scott (1985) established neotypes for some testate amoebae.

Generally, however, neotypification has not been practised widely in the protists. It was only recently that my own research group adopted this valuable approach to clarifying protist taxonomy and nomenclature (Foissner, 1997, 1999b; Foissner & Brozek, 1996; Foissner & Dragesco, 1996; Foissner & Kreutz, 1996; Petz & Foissner,

1996). However, it is a practice that several specialists have since followed (Agatha & Riedel-Lorjé, 1998; Petz et al., 1995; Song et al., 2001).

Neotypification is especially useful when:

- (1) no type material is available (holotype specimen and hapantotypes; see Article 73.3), but identification of the taxon is comparatively straightforward;
- (2) type material is available, but too poorly preserved for the diagnostic features to be recognizable. This situation may need to be referred to the Commission;
- (3) the original description is so incomplete and/or based on so few specimens that any identification becomes a matter of arbitrary judgement. Alternatively, such descriptions could be considered as referring to species indeterminate. However, this would greatly increase the number of scientific names because many original descriptions of ciliates are very incomplete. We prefer, where possible, to identify our taxa in relation to previously described species, and to redefine these species by detailed redescriptions. We ensure that the redescription is based on material which shares at least one main distinctive feature of the original material;
- (4) it has been argued that the species has one or more subjective synonyms. This indicates that the taxon has a questionable identity in the literature and, in the absence of type material, creates a 'classical' justification for neotypification;
- (5) there are several similar species whose identity will be fully differentiated by neotypification;
- (6) there are competing redescriptions for a taxon.

Article 75 of the Code

Most of the neotypes that my group has designated are in accordance with Article 75 of the Code. However, as protists form resting cysts, have a wide geographical distribution, and often lack any type material (Corliss, 1993), it is sometimes difficult to designate neotypes that fully satisfy Article 75. In some cases our ciliate neotype designations do not comply with Article 75.3.6 as they were not collected from or near the type locality. As such, these and similar neotypifications could be considered to be invalid. However, we do not consider Article 75.3.6 to be relevant to protist neotypes for the following reasons:

- (1) most ciliates and protists are cosmopolitan, at least at the morphospecies level (Finlay et al., 1996; Foissner, 1999a). In addition, many are symbionts, commensals, or parasites of metazoan animals that often have a much wider biogeographical distribution than the narrow definition of 'type locality' implies;
- (2) the existing uncertainties can be overcome only by making types universally available to protozoologists. The improvements in protist taxonomy that neotypification produces far outweigh the possible danger of misidentified neotypes that can occur from specimens selected out of original type locality;
- (3) as there are only a few alpha-taxonomists working with ciliates, it is difficult for them to obtain neotype material from or near the type locality. The application of Article 75.3.6 could prevent neotypes from ever being designated;

- (4) the likelihood of re-discovering ciliates and other protists at a certain locality is not guaranteed because the organisms may be in a dormant (cystic) stage for most of their life and laboratory cultivation is often unsuccessful.

Conclusion

To sum up, I suggest that neotypes of protists, especially ciliates, should be freed from the type locality regulation of Article 75.3.6 of the Code, provided that neotypification is based on a thorough redescription of the organism and usable neotype material has been deposited in an acknowledged repository. In addition, existing neotypes that have already been designated from other than original type localities should be validated by the Commission.

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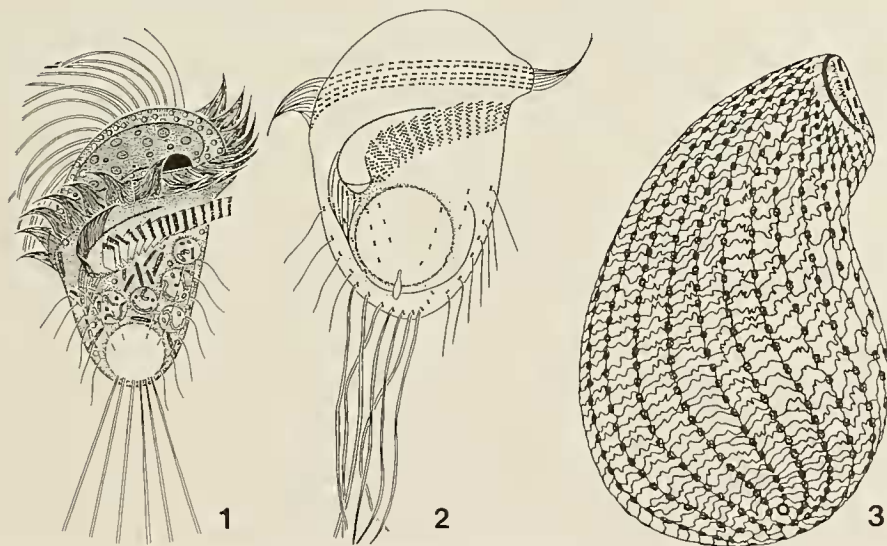
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Figs. 1–3. Two of several ciliate species neotypified in Foissner et al. (2002). 1, 2: Ventral views of *Metopus gibbus* Kahl, 1927 *in vivo* and after protargol silver impregnation. This species was erroneously synonymized with *M. striatus* McMurrich, 1884 in a recent revision. 3: Silver nitrate impregnated specimen of *Platyophryides latus* (Kahl, 1930), a species with a complicated taxonomic history settled by neotypification.